Towards a comprehensive and integrated knowledge-based urban development model: status quo and directions

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Abstract: Incorporating knowledge based urban development (KBUD) strategies in the urban planning and development process is a challenging and complex task due to the fragmented and incoherent nature of the existing KBUD models. This paper scrutinizes and compares these KBUD models with an aim of identifying key and common features that help in developing a new comprehensive and integrated KBUD model. The features and characteristics of the existing KBUD models are determined through a thorough literature review and the analysis reveals that while these models are invaluable and useful in some cases, lack of a comprehensive perspective and absence of full integration of all necessary development domains render them incomplete as a generic model. The proposed KBUD model considers all central elements of urban development and sets an effective platform for planners and developers to achieve more holistic development outcomes. The proposed model, when developed further, has a high potential to support researchers, practitioners and particularly city and state administrations that are aiming to a knowledge-based development.

Keywords: knowledge based urban development; knowledge based urban development models; urban planning; urban development; knowledge-based economy.

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1 Introduction

The 21st century marked the beginning of new advancements in the field of information and communication technology (ICT) which has impacted significantly on the overall spatial pattern and socio-economic fabric of cities (Castell, 2000). The issues of globalization and the ongoing transformation of advanced economies from manufacturing to services and then to knowledge-based activities has also engendered the knowledge society, which has influenced urban planning, development and mainly spatial aspects of cities (Drucker, 1998; Servaes, 2003). The rise of knowledge-based economy is also seen as the main driver of global and local economic development (Yigitcanlar, 2009a). The increasingly important transition into the knowledge-based economy requires conditions and environment, which are very different from those of the declining community-based economy (Knight, 1995). In this context, the aim of urban planning and development in the era of knowledge-based economy is to achieve a sustainable

development by creating a strong urban core, harnessing its economic strength, addressing social exclusion and avoiding physical dereliction. Cities must, therefore, formulate development strategies for their knowledge-based development (Sarimin and Yigitcanlar, 2011). As knowledge-based economy gains momentum all around the world, there is an urgency to analyze, quantify and qualify the foundations of cities, where knowledge is mainly produced, exchanged and marketed (Yigitcanlar, 2011).

The era of knowledge-based economy has led to the development of the notion of knowledge based urban development (KBUD) – a beneficial set of instruments put in place to improve the quality, welfare and competitiveness of cities (Yigitcanlar, 2007b). KBUD has gained popularity as a powerful strategy for sustainable economic, social and urban growth, and also for the post-industrial development of cities (Yigitcanlar et. al., 2008b). Although, the process of implementing KBUD approaches is neither simple nor quick as it has to be viewed from multidisciplinary angles, urban planners and developers, however, will still have to play a key role in deciding the future directions of cities' development (Ergazakis et. al., 2004).

There are currently many efforts put forward to the development of contemporary KBUD models and practical approaches. Many new methodologies, approaches, insights, concepts, views and contributions from various disciplines have been introduced, and they have impacted both the research community and real-life practitioners (Ergazakis et. al., 2006). Interestingly, the examination of present KBUD approaches has permitted to identify an emerging pattern, although a comprehensive and integrated generic model has yet to be established. This paper therefore, aims to scrutinize and compare the most popular KBUD models and practical approaches, and provide summary information by incorporating their key and common characteristics and features through utilizing the content analysis technique. Based on the findings, the paper proposes a new KBUD model that integrates all central elements of urban development and sets an effective platform for planners and developers to achieve more holistic development outcomes. The proposed model, when developed further, has a high potential to support researchers, practitioners and particularly city and state administrations that are aiming to a knowledge-based development.

Following this introduction, Section Two examines the relationship between knowledge-based economy and urban planning and development and explains how the shift in knowledge-based economy has impacted the socio-cultural and spatial aspects of city development. Section Three discusses KBUD as a new paradigm critical for urban planning and development. Section Four examines selected popular KBUD models identified from the literature, and determines their key shared features and characteristics that can be considered for integration in a new KBUD model. Section Five evaluates and summarizes these models common features and characteristics, and proposes a new KBUD model. Lastly, Section Six provides concluding remarks and points the directions for future research.

2 Knowledge-based economy and urban development

Globalization and rapid urbanization have changed the nature of cities' development. The era of knowledge-based economy and the subsequent birth of knowledge society concept have further influenced the shape of our cities (Yigitcanlar, 2010). Knowledge has positioned, stronger than ever before, as a key element in the production and creation of a vibrant economy, a prosperous society and a sustainable knowledge city (Metaxiotis et al., 2010). Howells (2002) argues that there are five ways in which geography and knowledge are interrelated (i.e., through human development, human interaction, human information, human learning and human interpretation whereby all are occurring in a geographical area). In this context, he further argues that both categories of knowledge, codified and tacit, play an equally important role in economic geography.

Organization for Economic Corporation and Development (OECD) (1996) defines knowledge-based economy as a term established to describe trends in advanced economies towards greater dependence on knowledge, information and high skill levels in human resources and combating social exclusion. The transition towards knowledge-based economy, which emphasizes on the production of knowledge, has certainly affected the process of urban development. There are a number of major changes brought about by the knowledge-based economy that are bound to have an impact on the patterns of human activity and urban living. Carrillo (2004) has categorized these changes into four aspects namely dematerialization (i.e., a lesser volume of material inputs and outputs); environmentalism (i.e., a greater concern with

sustainability); an experience upgrade (i.e., the capacity to attain the same results without the conventional means of space and time), and; essentialism (i.e., the understanding and pursuit of ever more fundamental values).

Knight (1995, 2008) argues that current city development has been viewed primarily from the perspective of city planning with a focus on their physical form and built environment (e.g., on land use zoning, building and infrastructure). Very little consideration has been given on their knowledge resources or to the cultures that produce knowledge. Previous emphasis has been made on attracting tangible forms of wealth (i.e., labor, land and capital) and knowledge as an intangible asset is often ignored. With the advent of the global knowledge society, there is a greater attention that needs to be given to the city structures and making that knowledge as an important input to local development.

Built environments that are planned for including intense knowledge-based activities differ significantly from those developed for commodity-based activities, and therefore, call for a different development strategy. Carrillo (2004, 2006) claims that the most immediate impact of the knowledge-based economy in relation to the urban environment is the reduction in displacements made possible by the Internet and wireless telecommunications. Working, schooling and shopping patterns will be changed substantially. Some of the most distinctive characteristics of an industrial city, such as commuting, suburban residence, central districts and zoning, in general are fading and they will be replaced by the distribution of work and learning, e-services, relocation of office spaces and zone reconversions. He further points out that the most important aspects of knowledge urban experience will no longer require presence and simultaneity, and, therefore, the current patterns of transportation, scheduling, configuration, zoning and infrastructure. The present configuration, organization and lifestyle of urban centers might be more of inheritance of tribal, hierarchical and material production patterns than an urban design and culture fit for knowledge society (Graham and Marvin, 1996). The new city designs should, for example, consider the notion of accessibility rather than proximity and contiguity, networked knowledge innovation zones rather than classical land use zoning, and the flow of information, goods and people rather than users and products' movement from one area to another.

Ergazakis et al. (2006) highlight that nations and international organizations have realized that the challenges facing modern societies call for new development strategies that are knowledge-based. The task for cities in the era of knowledge-based economy, which characterized by globalization, is that cities need to create environments where knowledge resources are valued, create conditions conducive to their development, and they must ensure that their knowledge resources are securely anchored (Knight, 1995). A knowledge-based approach to city development seeks to address the issue related to cities being a place where knowledge is created and marketed by providing a model for defining city's role as a knowledge centre. It is important to identify the need of city's knowledge sector and creating conducive city's environment for the knowledge-based activities. Knight (1995) argued that cultures producing global knowledge are of particular concern, because as these cultures develop, their local linkages weaken, distanced and disengaged from the affairs of the city. Within the same line, Knight highlighted in that "[t]he quality of life in cities will continue to decline unless cities protect local values and support efforts to valorize local knowledge" (Knight, 2008, p.xv).

The era of knowledge-based economy has therefore, confirmed on emergence of knowledge society, which requires a new urban planning and development approach. The reflection of this new model of society and how to build it put creating suitable milieus for knowledge generation, exchange and commercialization at the heart of the development. This leads to imagining a collaborative development model where growth is no longer viewed as an end itself, but simply as a means to reach the target by giving knowledge an unprecedented accessibility and by engaging in capacity-building for everyone. Lor and Britz (2007) argue that this knowledge society is not a goal but an outcome of an apparently irreversible development process, which Carrillo (2002, 2004, 2006) referred this process as a knowledge-based development. This whole scenario has certainly placed a crucial question on the quality of future cities particularly in answering to the global challenge of the era of knowledge-based economy and its answers will create even a bigger challenge for architects, urban designers, planners, developers, and decision-makers alike around the world.

3 Knowledge-based urban development

The advancement of understanding of knowledge and development has brought forth the alternative approaches to urban development. Urban planning has consolidated its interest in the paradigm of post-modern social production under the rubric of KBUD in recent years (Carrillo, 2004; Yigitcanlar et. al., 2008a). KBUD has become an important mechanism for the development of cities and seen as a beneficial set of instruments in order to improve the welfare and competitiveness of cities (Yigitcanlar, 2007b). Yigitcanlar (2011) provides a new definition to KBUD as "the new development paradigm of the knowledge era that aims to bring economic prosperity, environmental sustainability, a just socio-spatial order and good governance to cities, and produces a city purposefully designed to encourage the production and circulation of knowledge in an environmentally conserved, economically secure, socially just and well-governed human setting, a knowledge city" (p.354). The importance of KBUD within the paradigm of knowledge-based economy is regarded as the best alternative for the present practice of urban and regional planning to respond to the changes faced. Cities, being a place where such knowledge is created and marketed, need to respond effectively in order to promote a more sustainable socio-spatial order. The social benefits of KBUD also extend beyond aggregate economic growth as KBUD provides a platform for cities to be resilient to economic changes and secured in a network connections anchored at local, national and global coordinates. KBUD also offers quality of place to attract and retain talent. The promise of KBUD is a secure economy in human setting in line with the sustainable urban and economic development (Yigitcanlar, 2007b). Today, many scholar acknowledge that KBUD is the latest approach in urban planning and development, which offers a dynamic, strategic, flexibility and participatory planning and development mechanism (Yigitcanlar et al., 2012).

The creation of KBUD also presents significant new opportunities and challenges to the way the government, people and organizations think, operate, and manage their activities. In the knowledge era, KBUD needs to focus on catering and attracting knowledge-based activities and high-technology industries that are expected to contribute significantly to employment, gross domestic product and exports. Factors of production such as labor, capital, raw materials and entrepreneurship remain important but knowledge is the key driving force underlying growth and a valuable commodity, not only as a factor of production but also as a commodity to be traded (Hearn, 2008). There are ten important conditions that are conducive to the development of knowledge cities: the community is able to define, perceive and value knowledge as a form of wealth; the city acknowledges the importance and contribution of knowledge worker; the city is able to make the public understand the nature and role of knowledge; place knowledge resources at regional terms; give priority to improve knowledge infrastructure; ensure all members of society have access to careers in knowledge-based activities; promote city as a centre of excellent; offer incentives and mechanisms favoring investment in locally-based knowledge resources; futuristic vision emphasizing on knowledge and other immaterial factors, and; develop civic leadership (Knight, 1995).

What needs to be emphasized is that the development of knowledge-based economy requires a different city environment and KBUD is especially tailoring for this. KBUD concerns primarily with upgrading human and organizational capacities and creating environments, which are conducive to innovation, learning, creativity and change. KBUD transcends many areas of economic, social and urban policy, and has four broad purposes (Yigitcanlar et al, 2008d). Firstly, KBUD is an economic development strategy that codifies technical knowledge for the innovation of products and services, including urban services, market knowledge for understanding changes in the economy, financial knowledge to measure the inputs and outputs of production and development processes, and human knowledge in the form of skills and creativity, within an economic model (Lever, 2002). KBUD aims at a local economic development that is competitive and integrated with global knowledge-based economy. Secondly, KBUD indicates the intention to increase the skills and knowledge of residents and employees as a means for intellectual, human and social development (Gonzalez et al., 2005). KBUD aims to increase the quality of life by providing necessary services for societal development. Thirdly, KBUD builds a strong spatial relationship among knowledge community precincts for augmenting the knowledge spillover effect that contributes significantly to the establishment and expansion of creative urban regions and supports linkages and knowledge transfer between these precincts (Yigitcanlar et al., 2008c). KBUD also aims an urban development that is ecologically sensitive, sustainable and safe, a sustainable urban development. Fourthly, in KBUD perspective orchestration of the knowledge-based development of cities is critical to bring together all of the key actors and sources, organize and facilitate necessary knowledge-intensive

activities and plan strategically for knowledge city transformation (Yigitcanlar, 2011). In essence, the main attributes of KBUD are high levels of economic success, high levels of knowledge intensity, diverse knowledge industries, strong academic institutions, excellent communications and transport infrastructure, unique offering to investors and individuals, strategies to ensure all benefit from knowledge and economic success (Yigitcanlar et. al., 2008d). KBUD certainly sets a new paradigm of urban planning that bridge the tensions via an effective governance mechanism that normally exist among some forms of economic growth, social development and environmental concerns (Figure 1).

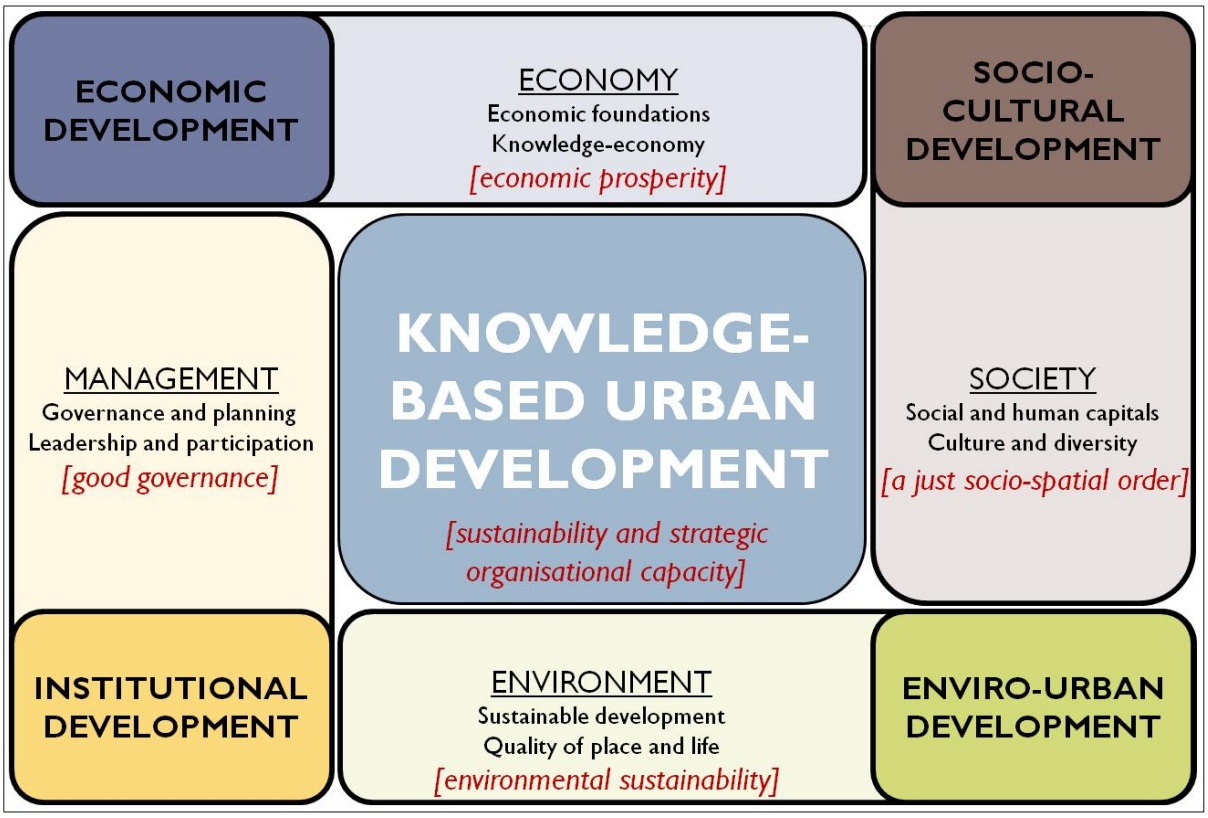

Figure 1 Knowledge-based urban development (Yigitcanlar, 2011, p.346)

4 Models of knowledge-based urban development

Many cities globally are now considered as successful in setting examples for implementing KBUD concepts, but only very few that have actually managed to successfully formulate integrated and strategic KBUD approaches. The initiatives and approaches of most cities are rather ad-hoc and not based on structured and specific methodologies. Heywood (2008) states that the measurement methods on KBUD normally vary based on the geographical area being observed (i.e., either at national, regional or municipal level) and therefore, leading for a more complex task towards the establishment of a common KBUD model. There are a number of international economic organizations such as the Organization for Economic Cooperation and Development (OECD), World Bank (WB), European Commission (EC) and Asia-Pacific Cooperation (APEC) that provide some practical guidelines and directions to build the knowledge-based economy via KBUD in both developed and developing countries (World Bank, 1999; APEC, 2000; European Commission, 2000; OECD, 2001). Nevertheless, there has been no viable, standardized and unified model to develop comprehensive and integrated KBUD strategies, and present models were produced in an era where KBUD is still at its infancy (Ergazakis et al, 2006; Dang and Umemoto, 2009). A study by Ergazakis et al. (2006) revealed that the present KBUD approaches are too fragmented and the need to follow a common approach is apparent. Similar conclusion was also concurred by a study conducted by Martinez (2006) on comparing the implementation of KBUD on selected cities.

Ergazakis et al. (2006) analyzed the KBUD approaches of six selected cities that have explicitly adopted KBUD in their urban development process (i.e., Barcelona, Stockholm, Munich, Montreal, Dublin and

Delft). Their research revealed that each city's approach in implementing KBUD concept is different although all are targeting towards the same set of goals. In the case of Barcelona, the city has developed a strategic plan to place the city into the leading group of urban regions in the ICT league. Delft has chosen a project-based approach and Stockholm followed a process-oriented approach. Meanwhile, Dublin and Montreal were focusing more on physical infrastructure and ICT related investment. Yigitcanlar (2009a) has also conducted a study on five cities that have adopted KBUD approach (i.e., Austin, Barcelona, Helsinki, Melbourne and Singapore). Although each city emphasized on different strategies, the research has concluded on some common and similar patterns in the KBUD implementations. Amongst others, the strategies include having a political and societal will and good governance, having a strategic vision and dynamic long term development plan, setting up agencies to promote KBUD, having a strong financial support, partnership and strategic investment, having international and multicultural character of the city, creating urban innovativeness engines, having research universities and excellent R&D institutes, having metropolitan web-portal, creating values to citizens, having quality of place and life, and finally, providing a low-cost access to advanced communication network.

This paper has selected the following five KBUD models: The MAKCi model; The KBUD Analysis model; The KBUD Characteristics model; The KnowCis model, and; The ALERT model. These are the most popular KBUD models that have been frequently referred in the literature. These models relate to the urban planning and development discipline and practice, and feature the key elements of sustainable urban development. These models contain specific characteristics of knowledge city foundations, which are concerned of aspects like knowledge, economic, socio-cultural and institutional bases, and emphasize on the quality of life and place, which covers aspects like urban diversity, accessibility and connectivity as well as social equity. The key features and characteristics identified from these models, therefore, are found suitable and used for the development of a new comprehensive and integrated KBUD model.

4.1 The Most Admired Knowledge City Model

The Most Admired Knowledge City Awards (MAKCi) is an international Delphi-based expert consulting exercise in determining the high achiever knowledge cities of the year. The award was first established in 2006 by the World Capital Institute to identify and recognize those communities around the world who have successfully engaged in formal and systematic knowledge-based development processes under the flag of knowledge cities. The MAKCi model gathers a number of indicators based on capital systems drawn from the research on knowledge-based development. The MAKCi model is fundamentally a KBUD model, which employs an assessment of the value base on the development of cities. The model has eight knowledge capital dimensions to stand as indicators for the KBUD model and all dimensions are equally weighted. The indicator-base offered by this model range from the elements relating to urban economic settings such as the financial capital to urban social settings such as human capital and from urban physical settings such as identity capital to urban organizational settings such as instrumental capital. Table 1 shows the thematic foci and indicators of the model and their descriptions (World Capital Institute, 2009).

Table 1 The MAKCi Model

Thematic foci and/or indicator categories	**Descriptions**
Identity capital	Refers to all formal and informal elements in the city that have contributed and/or are contributing to determine the city's identity, its clarity and differentiation (i.e., historic profile, city characterization, belonging, physical infrastructure and amenities, etc.).
Intelligence capital	Refers to the city's systems capacity, make sense of and respond to external agents and events, which are significant to the city's welfare (i.e., city's strategic planning agencies, city public/private future centers, prospective studies, etc.).
Financial capital	Refers to the city's articulation of monetary denomination of production value dimensions, which elicit economic sustainability within the capital system (i.e., macro indicators: investment, gross domestic product, tax system, un/employment, etc.).

Relational capital	Refers to the city's articulation capital that provides cohesion and makes social integration possible (i.e., ethnic diversity, individual health habits, intellectual and cultural competencies, etc.).
Human individual capital	Refers to value generating capacity of individual citizens that contribute to the city's system of capitals (i.e., health: biological inheritance and physical development; education: holistic personal development, etc.).
Human collective capital	Refers to the collective cultural fitness and team-based value generating capacities of all citizens that contribute to the city's system of capitals (i.e., demographic structure, public health, social welfare intellectual heritage, civic culture, innovation and entrepreneurial capacities, etc.).
Tangible instrumental capital	Refers to the material-based means of production through which other capitals leverage their value generating capacity (i.e., instrumental capital includes natural existing before the settlement and infrastructure, etc.).
Intangible instrumental capital	Refers to the knowledge-based means of production through, which other capitals leverage their value generating capacity (i.e., organization and production systems in electronic and non electronic repositories, etc.).

Note: Derived from World Capital Institute (2009)

4.2 The KBUD Analysis Model

The KBUD analysis model introduced by Yigitcanlar (2008a) has classified the requirements of a city, which aspires for KBUD into four different domains (i.e., economy, society, environment, and management) as shown in Table 2. Firstly, Yigitcanlar (2008a) suggests a vibrant economic environment, where a strong economic development strategy is present to codify technical knowledge for innovation, market and financial knowledge as well as human knowledge in the form of skills and creativity. He further emphasizes that the economic environment must create a local economic development that is competitive and integrated with the local economy. Secondly, KBUD needs a societal environment, where an effective education and skill building strategies exist in order to increase skills and knowledge of residents and workers. Thirdly, KBUD requires a physical environment, where a strong spatial relationship among knowledge clusters augment the knowledge spillover effect that contributes to the establishment and expansion of creative urban regions and support linkages and networking between clusters. The physical environment also requires incorporation of sustainable urban development and urban design principles for increasing the quality of place and natural environment preservation. Lastly, KBUD requires an institutional arrangement, management, to oversee and governance of the development.

Table 2 The KBUD Analysis Model

Thematic foci and/or indicator categories	**Descriptions**
Economy	Strong economic development strategy that codifies knowledge (i.e., knowledge-based, competitive, creative and innovative, etc.).
Society	Effective education and skill building strategies (i.e., quality of life, human and social development, intellectual capital, etc.).
Environment	Strong spatial relationship among knowledge clusters (i.e., quality of place, sustainable, unique identity, urban design, environmental preservation, etc.).
Management	Institutional arrangement to oversee development (i.e., strategic and integrated, democratic and transparent, social equity, etc.).

Note: Derived from Yigitcanlar (2008a)

4.3 The KBUD Characteristics Model

The KBUD characteristics model introduced by van Winden et al. (2007) has discerned seven structural thematic foci that are conducive to the city in coping with the requirements of the knowledge era. These thematic foci are deemed necessary for a city to be able to acquire, create, disseminate and use

knowledge effectively for greater economic and social development. These thematic foci also form seven main indicator categories of the KBUD strategy namely the knowledge base, industry structure, quality of life, diversity, accessibility, social equity and scale. Table 3 shows these seven indicator categories and their descriptions.

Table 3 The KBUD Characteristics Model

Thematic foci and/or indicator categories	**Descriptions**
Knowledge base	Cities with a high level of workers with tertiary education (i.e., knowledge workers) show a better performance on many economic parameters.
Industry structure	Cities with a weak industrial structure (i.e., specialized in traditional industry) have many interrelated problems.
Quality of life	Cities that offer a good quality of life will attract and retain talented population and investment.
Diversity	Cities that are more diverse will foster growth, due to cultural vibrancy that is an important factor in attracting and retaining talent and investment.
Accessibility	Cities with high accessibility and international connection are more successful in acquiring knowledge.
Social equity	Cities with high level of social exclusion indicates that large parts of its population are insufficiently used.
Scale	City size matters as an attraction factor for knowledge companies and knowledge workers due to quality and number of service availability.

Note: Derived from van Winden et al. (2007)

4.4 The KnowCis Model

The KnowCis model was developed by Ergazakis et al. (2006) to assist and support local authorities in the process of planning and developing their cities as knowledge cities. The model has nine distinctive dimensions and features as shown in Table 4. The model was incorporated in a pilot knowledge city development initiative in a Greek municipality. According to Ergazakis et al. (2006) the model can be easily adopted in municipal systems as the proposed approach is generic enough to be suitable for many local governments with different sizes. Ergazakis et al. (2006) stated that the pilot experiments in Greece has showed that the model is useful for each city to determine their existing KBUD strengths in the process of their knowledge city transformation.

Table 4 The KnowCis Model

Thematic foci and/or indicator categories	**Descriptions**
Concept	Promotion of the knowledge city concept and continuous improvement of concepts' visibility.
Support	Improvement of knowledge systems and their management process within the city and its region.
Infrastructure	Improvement of ICT infrastructure of the city and citizens' ICT literacy level via investment.
Participation	Assurance of equal participation and involvement of all citizens in the decision-making process.
Business environment	Support for research, business innovation and entrepreneurship activities and initiatives.
Public sector	Reinforcement of public sector's role in promoting and sustaining the concept of knowledge city.

Networking	Strengthening of networking and synergies between all social actors within and beyond the city boundaries.
Human skills	Investing on increasing the availability and skill level of human capital via education and training projects.
International network	Enhancement of the inclusive, international and multi ethnic-character of the city via local and international events.

Note: Derived from Ergazakis et al. (2006)

4.5 The ALERT Model

The ALERT Model, developed by Corey and Wilson (2006), is a KBUD approach and a normative support system for local and regional planning practice in the global economy and network society. The model, which is represented in the form of conceptual framework, is a planning support system designed for the use of the diverse and wide-ranging stakeholder and planning practitioners, who seek to engage planning in the steering of these new technology-enabled and knowledge-based development forces to attain desired outcomes. The ALERT model can catalyze and stimulate the stakeholders to invent their own KBUD strategies that capitalize on the unique assets and development potential of the locality's community. The acronym of ALERT is derived from the keywords that define the content of the model: Awareness, Layers, E-business (electronic-business), Responsiveness and Talk. Table 5 shows the key thematic foci of the ALERT model in relation to KBUD.

Table 5 The ALERT Model

Thematic foci and/or indicator categories	**Descriptions**
Awareness	Continuously updating information (i.e., compare local facts and economic profile to elsewhere best practice peer city regions; actionable knowledge level, etc.).
Layers	Understand the present position (i.e., identify principle competitor city-regions; global and national, etc.).
E-business	Present state of a locality's business assets and resources (i.e., analyze and evaluate the state of the locality's business assets and resources, etc.).
Responsiveness	Access to opportunities, amenities and services (i.e., levels of responsiveness, e-government, broadband, etc.).
Talk	Engagement and collaborative behavior among the principal representative stakeholder individuals, institutions and organizations (i.e., governance, human capital development, enterprise culture development, etc.).

Note: Derived from Corey and Wilson (2006)

5 Status quo and discussion

The examination of present KBUD models in the previous section shows that there are only a handful of models developed for KBUD. Each of these models offers a conceptual difference for the establishment of KBUD models. Common characteristics and key features, however, draw a pattern of recurrence among them, and these recurring elements can easily be identified and grouped accordingly. In general, all models attempted to meet the promise of KBUD of securing economy in a human setting. In other words, the strategies outlined in these models are aiming for KBUD by focusing on four major objectives (i.e., economic, human and social, physical urban environment, and finally, institutionalization and management). The emphases on economic aspects can be seen from the strategies to codify technical knowledge for the innovation of products and services, market knowledge for understanding changes in consumer choices, financial knowledge to measure the inputs and outputs of production and development processes, and human knowledge in the form of skills and creativity within the economic model. In meeting human and social development, the KBUD strategies outlined in these models indicate the intention to increase the skills and knowledge of residents as a mean for individual and community development. As for the physical urban development, all of the models aim at building a strong spatial network relationship between components of urban development and preparing a physical urban

environment that is conducive for knowledge production and attracting talent and investment. Lastly, the strategies within the KBUD models are also focusing on the aspect of institution and management, whereby this domain acts as a key to orchestrate KBUD and bring together all the key actors and sources in order to organize and facilitate the necessary knowledge-intensive activities and plan strategically for knowledge city transformation.

To provide a summary of the model comparison Table 6 simplifies and groups the common key thematic foci and/or indicator categories identified from the five popular KBUD models discussed in the previous sections. The common features and characteristics can be categorized under four major domains (i.e., economy, society, environment and management). A careful examination of these models, however, suggests that, there is a room for modifications that may lead to the establishment of a more comprehensive and integrated KBUD model. Although all models have more or less completely cover the basic elements necessary in urban planning and development (i.e., economy, society, physical environment, and governance), there is still some adjustment required. This overview that highlight the status quo of the existing KBUD models has also shown that all characteristics or indicators within the examined models are equally emphasized (i.e., models used either no weightings or only equal weightings) and hence, this may have an affect on the validity of these models' outcomes.

Table 6 Salient features of the KBUD models

Thematic foci and/or indicator categories	**The MAKCi Model**	**The Analysis Model**	**The Characteristics Model**	**The KnowCis Model**	**The ALERT Model**
Economic development	Financial capital *(Eco)*	Economy *(Eco)*	Diversity *(Eco)*	Business environment *(Eco)*	E-business *(Eco)*
Social and cultural development	Relational capital *(Soc)*	Society *(Soc)*	Knowledge base *(Soc)*	Participation *(Soc)*	Talk *(Soc)*
	Human individual capital *(Soc)*		Social equity *(Soc)*		
	Human collective capital *(Soc)*				
Physical environment and urban development	Tangible instrumental capital *(Env)*	Environment *(Env)*	Industry structure *(Env)*	Concept *(Env)*	Layers *(Env)*
				Infrastructure *(Env)*	
	Identity capital *(Env)*		Quality of life *(Env)*		
			Scale *(Env)*		
Management, governance and institutional development	Intelligence capital *(Man)*	Management *(Man)*	Accessibility *(Man)*	Public sector support *(Man)*	Responsiveness *(Man)*
	Intangible instrumental capital *(Man)*			Networking *(Man)*	

Note: *Eco* – Economy; *Env* – Environment; *Soc* – Society; *Man* – Management

Following to the review of existing KBUD models, this paper illustrates a sample framework of an integrated and comprehensive KBUD model. Table 7 shows the exemplar proposed framework for the

development of a more comprehensive and integrated KBUD model. The model is developed based on the common key features identified from the popular KBUD models, with a further elaboration on measuring the domains. While the columns of thematic foci and indicator sets are more general in identifying the elements that need to be incorporated in the KBUD model, the indicators and description columns are more specific in providing elements that are quantifiable and measurable. The characteristics that need to be included in the model are categorized under four thematic foci (or indicator categories) covering all major aspects of urban planning and development (i.e., economic development, socio-cultural development, enviro-urban development and institutional development). The proposed KBUD model contains the necessary characteristics, or in other words indicator sets, as well as indicators and their descriptions for a comprehensive and integrated KBUD modeling. Presently, the model uses an equal weighting and when further developed and operationalized the model will also have assigned varied weightings for the KBUD indicator categories, indicator sets, and indicators.

Table 7 The Comprehensive and Integrated KBUD Model

Thematic foci and/or indicator categories	**Indicator sets**	**Indicators**	**Descriptions**
Economy – Economic development	Knowledge-based	Knowledge industries and businesses	Level of knowledge industries and businesses
		R&D centers	Level of R&D centers
	Competitive	Foreign direct investment	Level of foreign direct investment
		Multinational headquarters	Level of multinational headquarters
	Creative and innovative	Creative industries	Level of creative industries
		Patents	Level of patents per year
Society – Socio-cultural development	Quality of life	Housing affordability	Level of housing affordability for average income group
		Community facilities	Level of community facilities per capita
	Human and social development	Social capital	Level of social tolerance
		Literacy rate	Level of literacy rate
	Intellectual capital	Level of education	Level of population with tertiary education
		Knowledge workers	Level of knowledge workers per capita
Environment – Enviro-urban development	Quality of place	Green area	Level of green parks per capita
		Urban amenities	Level of selected urban amenities per capita
	Sustainability	Public transport initiatives	Level of government budget on public transport
		Environmental programs	Level of government budget on environmental programs
	Unique identity	Cultural factors	Level of ethnicity and diversity
		Cultural facilities	Level of cultural facilities

Management – Institutional development	Strategic and integrated	Vision of organizations	Level of vision of the organization
		Multidisciplinary personnel	Level of personnel within the organization
	Democratic and transparent	E-government	Level of government services with e-facilities
		E-planning and e-submission	Level of e-submission for planning application
	Social equity	Wealth distribution	Level of wealth distribution
		Access to employment	Level of unemployment

Note: Derived from Ergazakis et al. (2006), Corey and Wilson (2006), van Winden et al. (2007), Yigitcanlar (2008a), World Capital Institute (2009), Yigitcanlar (2011)

6 Conclusions and directions

The development directions that KBUD offers are very important in setting the future development path of a city's growth. In the era of knowledge-based economy, where knowledge is a crucial element to promote growth, KBUD is a new paradigm in the development that can provide a sustainable form of development and potentially make cities more competitive, livable and globally oriented. In order to facilitate KBUD, cities need to have a strong economic, physical environment, knowledge, administrative and socio cultural bases. To provide a clear understanding on how KBUD works this paper scrutinizes, summarizes and compares some of the popular KBUD models and concludes that these KBUD models are fragmented, not unified and neither comprehensive nor integrated enough. Each model signifies different strategies, although, their key characteristics are leading towards the same goal of achieving a sustainable KBUD. There are various approaches and emphases that each model has developed. However, there are some similar trends and common characteristics and features that can be identified from these models. A pattern of recurrence of the significant features and their key findings can be traced from the analysis conducted, and would be useful in developing a more integrated and comprehensive model.

The findings of the review revealed that the KBUD conception is still evolving in order to produce more sustainable outcomes for city planning and development. The debate in the literature signifies that the process of implementing KBUD approaches and strategies is neither simple nor quick and some argue that the issues should be viewed from the multidisciplinary angles. However, the review of the KBUD models provides us an opportunity to develop a prototype or generic comprehensive and integrated model, the proposed KBUD model. The proposed KBUD model incorporates four major domains (i.e., economy, society, environment, and management). Each of these domains contains relevant indicator-sets, indicators and appropriate weightings still need to be assigned to them in order to ensure a more effective and valid model outcomes. This modeling exercise has moved us another step forward towards the establishment of a unified and integrated KBUD model, hence, still more needs to be done for this model to become fully operationalized. A careful indicator selection, pilot testing and model fine-tuning are required in order to ensure that the new KBUD model is reliable, efficient and effective and leads our cities towards achieving desired sustainable knowledge-based development outcomes.

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